DESCRIPTION

PAPER SHEET TREATING DEVICE

Technical Field:

The present invention relates to a paper sheet treating device associated with a copying machine or a printer device for performing an aftertreatment such as a punching treatment or a stapling treatment and, more particularly, to a paper sheet treating device which is improved in a treating precision and raised in a treating speed.

Background Art:

There has been known either a composite device for stapling printed paper sheets by combining an electric stapler with the copying machine or the printer device, or a composite device in which a punching device is combined so as to operate a punching treatment to the printed paper sheets so that a binder can be attached to the sheets. The composite device of this kind is required for a high precision in a position control or registration of paper sheets at the time when the sheets are fed after printed to the stapler or the punching device for the stapling or punching treatment, and for a high speed not inferior to the printing speed.

As the means for correcting the skew (i.e., an inclination of a paper sheet with respect to the sheet feeding direction)

of the sheet being sent thereby to accumulate the sheets in registration, there has been proposed the "accumulation adjusting fuzzy control device for paper sheets or the like", as disclosed in JP-B2-2760127. In the accumulation adjusting fuzzy control device, the individual rotating speeds of feed rollers halved in the width direction of the paper sheets are controlled by fuzzy inference control means to correct the skew of the paper sheets thereby to accumulate the sheets without any skew.

There is also known a punching device (e.g., JP-A-2003-291093), in which the treatment standby time is shortened to improve the productivity by transferring the paper sheets such that the leading portion of a succeeding sheet overlaps the trailing portion of a preceding sheet.

The means for feeding the paper sheets while being corrected in position to have no positional deviation to the punching device or the stapler uses the widthwise separated feed rollers, as disclosed in the invention of JP-B2-2760127, to control the individual rotating speeds of the separate feed rollers thereby to correct the skews of the sheets. The means is so complicated in its control system as to require a control unit capable of high-speed operations so that it has a high cost.

For positioning the feed direction of the sheets, moreover, the constitution is generally made such that the leading end of the sheet is inserted and positioned between the paired

discharge rollers to contact each other. However, the abutting face of the sheet is not flat so that its positioning precision is poor thereby to raise a problem that the sheet position is liable to disperse.

In the constitution for positioning the sheet by bringing its leading end into abutment against a fence for a positioning reference, moreover, the positioning precision is satisfactory, but the sheet is reversely discharged after punched or stapled, so that the feed mechanism is complicated to invite a reduction in the treating speed.

In the constitution which is intended to shorten the standby time period between treatments by feeding the succeeding sheet subsequent to the sheet fed to the punching device or the stapler device and by holding the succeeding sheet standby with its leading portion being laid over the trailing end of the preceding sheet thereby to improve the treating speed, moreover, the leading end of the succeeding sheet may abut against the trailing end of the preceding sheet, or the succeeding sheet may proceed below the lower side of the preceding sheet thereby to cause the feeding failure.

As an example of the punching device to be used in the composite device of the kind, on the other hand, there is known a constitution (e.g., JP-A-2001-139217), the printed paper sheet inserted between a die and a punch is punched by keeping the punch, which ascends to the die, at an upper standby position by a spring and by pushing down the punches by a cam against

the spring force.

The punching device to act in association with the copying machine is required to have such a high speediness that the punching treatment may not become a bottleneck against the entire treating speed. However, the punching device constituted to keep the punches at the upper standby position by the spring takes a considerable time for the descending stroke because it pushes down the punches against the spring force. Especially the case of multiple punches of several tens has a high punching load and a larger weight than that of the two-hole punches so that it requires a power source of a high capacity and takes a cost high. In the ascending stroke, moreover, the punches are promptly lifted by the spring bias but have a large inertia biased by the spring thereby to raise a problem that they take a long time till they stop.

As the punching device to be used in the composite device of the kind, moreover, there has been proposed a device (e.g., JP-B2-3336203), which has a punch mechanism portion made exchangeable as a unit. The device is equipped with means for discriminating the kind of the punching unit mounted on the body, and control means for controlling the punching treatment in accordance with the kind of the punching unit discriminated. Thus, the device controls the transfer speed or the punching operation timing of the sheets.

Since the punching mechanism portion including the punches

and the die is made as a unit, these punches and die can be easily replaced in case they are worn or damaged. Due to the tolerances or assembly errors of the individual parts composing the punching unit, however, the positional relations between the paper sheet and the punches of the punching unit, which are positioned by the sheet feed mechanism or the positioning mechanism on the body side, are not fixed when the punching unit is mounted on the punching device, thereby to cause errors in the positions of the punched holes.

Disclosure of the Invention

Therefore, the present invention has an object to provide a paper sheet treating device which can perform high-speed treatments with a simple constitution and which is excellent in the positioning precision of paper sheets and in the feeding stability of the sheets.

Another object is to provide a paper sheet treating device which is equipped with an aftertreatment device such as a punching device having a cycle time period shortened to raise the treating speed.

Still another object is to provide a paper sheet treating device which is equipped with a punching device eliminating the deviation in the positional relation among the punches of a punching unit, a die and paper sheets thereby to prevent the positional errors of punched holes.

In order to achieve the aforementioned objects, according

to the invention, there is provided a paper sheet treating device, in which a paper sheet is fed to a sheet table by sheet feed means so that the sheet on the sheet table is punched or stapled by a stapler. The paper sheet treating device is constituted such that a closing type vertical fence is disposed at the downstream side leading end of the sheet table, such that a pair of feed rollers to contact with each other are disposed upstream of the closing type fence, such that the sheet on the sheet table is pushed onto the closing type fence by the feed rollers and positioned, and such that the closing type fence is opened after the punching treatment or the stapling treatment thereby to discharge the sheet.

Moreover, the sheet treating device may also be constituted such that feed rollers disposed upstream of the closing type fence are mounted on a spindle through torque limiting means such as sliding clutches, such that when the leading end of the sheet on the sheet table abuts against the closing type fence, such that the feed rollers are caused to stop their rotations by the torque limiting actions while applying a forwarding force to the sheet, thereby to hold the sheet on the closing type fence.

Moreover, the sheet treating device may also be constituted such that the feed rollers mounted on the spindle through the torque limiting means are arranged by two through a clearance in the direction perpendicular to the sheet feeding direction.

Moreover, the sheet treating device may also be constituted such that positioning plates capable of widening/narrowing the mutual spacing and a drive mechanism therefor are disposed on the two right and left sides of the sheet table so that the sheet fed onto the sheet table may be interposed between the two right and left sides by the positioning plates thereby to correct the positional deviation and the positions in the transverse direction.

Moreover, the sheet treating device may also be constituted such that feed roller opening/closing control means is provided for opening the paired feed rollers interposing the two upper and lower faces of the sheet, when the positioning plates are reduced in their spacing, thereby to release the pressure of the sheet, and for narrowing the paired feed rollers after the end of the narrowing of the positioning plates.

Moreover, the sheet treating device may also be constituted such that control means is provided for executing the individual steps of introducing the sheet into the sheet table, correcting the positional deviation and the position of the sheet, punching or stapling the sheet, opening the closing type fence and discharging the sheet, in a manner overlapped in a time scale.

Moreover, the sheet treating device may also be constituted such that a rotary flap is disposed on the upstream end of the sheet table, and such that control means is provided for rotating, when the sheet is fed onto the sheet table, the rotary

flap to cover the upper face of the trailing end of the sheet.

Moreover, the sheet treating device may also be constituted such that the punching device includes a die, punches and a punch lifting mechanism for ascending/descending the punches with respect to the fixed die thereby to punch the sheet, and such that the punches are biased toward the die by the spring so that the punch driving force of the punch lifting mechanism and the spring force of the spring may coact to punch the sheet.

Moreover, the sheet treating device may also be constituted such that the punch lifting mechanism includes a motor, a crankshaft adapted to be driven by the motor, and a link for connecting the crank pin of the crankshaft and the punches.

Moreover, the sheet treating device may also be constituted such that the punching device includes a click stop mechanism for holding the punches at standby positions.

Moreover, the sheet treating device may also be constituted such that the click stop mechanism includes a disc cam having a groove formed in its outer circumference and mounted on the crankshaft, and such that a roller and a pawl is made to contact elastically with the groove thereby to hold the punches at the standby positions.

Moreover, the sheet treating device may also be constituted such that the punching device can mount the punching unit having

the punches and the die removably on the punching device body, such that a sheet positioning mechanism is provided for correcting the position of the sheet in the direction perpendicular to the transfer, and such that the punching device body includes read means for reading the positional deviation information, and control means for controlling the sheet positioning mechanism in accordance with the positional deviation information read, thereby to correct the position of the sheet in the direction perpendicular to the transfer so that the positional deviations of the punches and the die are eliminated.

Moreover, the sheet treating device may also be constituted such that the sheet positioning mechanism includes a reference positioning unit and a movable positioning unit for pushing the sheet toward the reference positioning unit, and such that the position of the reference positioning unit is corrected according to the positional deviation information read from the positional deviation information storage means of the unit.

Moreover, the sheet treating device may also be constituted such that the positional deviation information storage means includes one or more dip switches.

Moreover, the sheet treating device may also be constituted such that the positional deviation information storage many includes a nonvolatile memory.

Brief description of the drawings:

Fig. 1 is a top plan view of a punching device and shows an embodiment of the invention.

Fig. 2 is a sectional side elevation of the punching device.

Fig. 3 is a sectional back view taken line A - A of Fig. 1.

Fig. 4 is a top plan view showing an arrangement of a mechanism portion of the punching device.

Fig. 5 is a side elevation showing the arrangement of the mechanism portion of the punching device.

Fig. 6 is a back elevation showing the arrangement of the mechanism portion of the punching device.

Fig. 7 is a back elevation showing the arrangement of the mechanism portion of the punching device.

Fig. 8 is a perspective view showing the arrangement of the mechanism portion of the punching device.

Fig. 9 is a perspective view of a rotary flap.

Fig. 10 is a sectional side elevation of a feed roller and rotary flap portion of the punching device.

Fig. 11 is a perspective view showing an arrangement of a jog roller and a closing type fence.

Fig. 12 is a perspective view of a body frame and a punching unit.

Fig. 13 is a back elevation of the punching unit.

Fig. 14 is a top plan view showing an arrangement of the

mechanism portion of the punching unit.

Fig. 15 is a side elevation showing the arrangement of the mechanism portion of the punching unit.

Fig. 16 is a back elevation showing the arrangement of the mechanism portion of the punching unit.

Fig. 17 is a perspective view showing the arrangement of the mechanism portion of the punching unit.

Fig. 18 is a perspective view showing the arrangement of the mechanism portion of the punching unit.

Fig. 19 is an action timing chart of the punching device.

Fig. 20 is a control flow of a sheet positioning mechanism.

In the reference numerals in the drawings, 1: a punching device, 3: feed rollers, 4: discharge rollers, 5: sheet table, 6: a punching unit, 7: punches, 8: a die plate, 9: a closing type fence, 12: jogging rollers, 13: pinch rollers, 14a: a positioning reference plate, 14b: a movable positioning plate, 15: a rotary flap, 16: a front sheet detecting sensor, 17: a rear sheet detecting sensor, 27: a torque limiter, 28: a spindle, 29: a support shaft, 30: rotary links, 31: levers, 32: pinch roller lifting solenoids, 41: handle, 42: a flange panel, 43: positioning bosses, 44: dip switches, 45: a switch substrate, 46: a frame, 47: a punch support plate, 48: slide guides, 49: links, 50: a crankshaft, 54: compression coil springs, 55: a disc cam, 56: a stop lever, 57: a roller, 58: a compression

coil spring, 63: a spindle, 64: pawls, 65: a compression coil spring, 66: a link, and 67: a lever.

Best Mode for Carrying Out the Invention:

Embodiments of the invention will be described with reference to the drawings.

<Embodiment>

Fig. 1 to Fig. 4 show a sheet treating device which is equipped with a punching device 1 as an aftertreatment device. As shown in Fig. 2, the punching device 1 is constituted by arranging a pair of upper and lower feed rollers 3 in the front portion (as located on the right side) of a frame 2, as shown, and by arranging a pair of upper and lower discharge rollers 4 in a rear portion so that a paper sheet discharged from the (not-shown) copying mechanism unit is pulled by the feed rollers 3 and sent rearward on a horizontal sheet table 5 and is punched by a multi-hole punching unit 6 arranged just upstream of the discharge roller 4 and then discharged rearward by the discharge roller 4.

The punching unit 6 is equipped with a 30-hole type punch 7, a die plate 8, and a closing type fence 9 acting as a sheet stopper on the downstream side (as located on the left side in Fig. 2) of the sheet feed. The punching unit 6 mounts a punch driving motor 10 and a fence driving solenoid 11. Just upstream of the punching unit 6, there are arranged jogging

rollers 12 and pinch rollers 13 for sending the sheet on the sheet table 5 toward the closing type fence 9 so that the sheet is transversely interposed between a positioning reference plate 14a and a movable positioning plate 14b arranged on the two right and left ends of the sheet table 5 and is positioned in the longitudinal direction by being pushed onto the closing type fence 9 by the jogging rollers 12 and the pinch rollers 13.

Just at the rear of the sheet roller 3, on the other hand, there is arranged a rotary flap 15, by which the trailing end of the sheet pulled onto the sheet table 5 by the feed rollers 3 is held so that the sheet is prevented from floating.

Sheet detecting sensors 16 and 17 are arranged just in front of the feed rollers 3 and slightly in front of the jogging rollers 12, respectively. When the front sheet detecting sensor 16 detects the sheet, the feed rollers 3 is started to send the sheet rearward. When the rear sheet detecting sensor 17 detects the sheet sent, the movable positioning plate 14b on the left side (as located on the lower side in Fig. 4), as viewed from the upstream of the sheet transfer direction, comes close to the positioning reference plate 14a by the width of the sheet thereby to correct the positional displacement of the sheet, so that the sheet is punched after it comes into abutment against the closing type fence 9.

The constitution of the action mechanism is described in the following. Fig. 4 to Fig. 6 are three-face views showing

the arrangements of the individual rollers and the punching mechanism; Fig. 7 is an arrangement diagram taken obliquely from the front; and Fig. 8 is an arrangement diagram taken obliquely from the back. Of the pairing feed rollers 3, the lower roller (Fig. 4) is rotationally driven by a sheet feed motor 18, and the rotary flap 15 is turned by a flap driving motor 19. As shown in Fig. 9, the rotary flap 15 is shaped such that a plurality of flap members 21 are fixed at a spacing on a spindle 20, and the flap members 21 are shaped such that two flaps 21b extending tangentially from the outer circumferences of sleeve portions 21a are arranged symmetrically of 180 degrees. A rotary disc 22 is fixed on the end portion of the spindle 20, and two notches 22a formed at an interval of 180 degrees in the rotary disc 22 are sequentially detected by a photo interrupter 23 so that the rotary flap 15 may be turned by 180 degrees.

As shown in Fig. 10, the rotary flap 15 is arranged at the rear of the sheet table 5 which is lower one step than a sheet drawing slot 24, and is positioned such that the flaps 21b stop horizontally at a position slightly higher than the sheet table 5. When the sheet is pulled by the feed rollers 3 and sent downstream by the jogging rollers 12 so that its trailing end moves over the sheet table 5, the rotary flap 15 is turned by 180 degrees so that the trailing end of the sheet is pushed down by the flaps 21b. When a next sheet P2 is pulled, therefore, its leading end is guided over the flaps

21b to above a preceding sheet P1. As a result, the leading end of the succeeding sheet P2 is prevented from colliding against the trailing end of the preceding sheet P1 or from entering the lower face side of the preceding sheet P1 so that the sheets can be reliably laid one over the other.

Subsequently, a sheet positioning mechanism 104 and the jogging rollers 12 are described. The movable positioning plate 14b (or the movable positioning portion 14b) on the left side (as located on the lower side in Fig. 4), as shown in Fig. 4, is jointed to a timing belt B, which is made to run on a pair of (not-shown) transversely spaced gear pulleys. The timing belt B is driven by a positioning plate driving motor 25, as shown in Fig. 5, so that the movable positioning plate 14b is brought in accordance with the turning direction of the timing belt B close to and away from the positioning reference plate 14a (or the positioning reference portion 14a) along the not-shown slide guide. Here, the positioning reference plate 14a and the movable positioning plate 14b constitute a pair of positioning plates.

As shown in Fig. 20, the positioning reference plate 14a can be moved rightward and leftward by a jogging mechanism 14c such as a feed screw mechanism but is fixed at an ordinary running time. When the punching unit is mounted, the control unit reads position correcting information from the punching unit and drives the jogging mechanism 14c in accordance with that information thereby to correct the position of the

positioning reference plate 14a.

When the rear sheet detecting sensor 17 arranged between the positioning reference plate 14a and the movable positioning plate 14b detects the paper sheet sent, the positioning plate driving motor 25 is started to drive the movable positioning plate 14b rightward thereby to reduce the spacing between the positioning reference plate 14a and the movable positioning plate 14b to the sheet width so that the sheet is interposed inbetween to have its center positioned at the transverse center of the punching unit 6.

In the embodiment, the movable positioning plate 14b is moved transversely relative to the positioning reference plate 14a thereby to position the sheet transversely. In another constitution, however, the two plates 14a and 14b may also be simultaneously driven to come close to or apart from each other. In the constitution, the timing belt B is made to run on the (not-shown) paired gear pulleys which are transversely (or longitudinally in Fig. 4) spaced, and one positioning plate 14a is fixed on the front row side of the timing belt B whereas the other positioning plate 14b is fixed on the rear row side of the timing belt. The timing belt B is driven by the positioning plate driving motor 25, as shown in Fig. 5, so that the two plates 14a and 14b are symmetrically brought close to or away from each other along the not-shown slide guides in accordance with the turning direction of the timing belt B. When the sheet detecting sensor 17 arranged between the two plates 14a

and 14b detects the sheet sent, the positioning plate driving motor 25 is started to drive the two plates 14a and 14b close to each other thereby to reduce the spacing between the positioning reference plate 14a and the movable positioning plate 14b to the sheet width so that the sheet is interposed inbetween to have its center positioned at the transverse center of the punching unit 6.

As shown in Fig. 5 and Fig. 11, the jogging rollers 12 and the discharge rollers 4 acting as lower rollers positioned on the reverse side of the sheet are rotationally driven by one sheet discharging roller 26 through one belt. As shown in Fig. 11, the jogging rollers 12 are individually attached to the right and left of a spindle 28 through torque limiters 27 acting as torque limiting mechanisms. The paper feed is performed by pushing the pinch rollers 13, which are positioned on the obverse side of the sheet to act as the upper rollers, downward onto the jogging rollers 12, but is not performed if the pinch rollers 13 are raised to leave the jogging rollers 12. A support shaft 29 of the pinch rollers 13 are attached at its two ends to rotary links 30 so that the pinch rollers 13 are ascended or descended by pushing or pulling levers 31 attached to the rotary links 30 with pinch roller lifting solenoids 32. In short, a sheet feed roller lifting mechanism is constituted of the rotary links 30, the levers 31 and the pinch roller lifting solenoids 32.

The two jogging rollers 12 are attached individually through

the torque limiters 27 to the spindle 28. When the leading sheet end on one jog roller abuts against the closing type fence 9, therefore, that jogging roller stops its rotation whereas the other jogging roller continues its rotation. As a result, the leading sheet end on the jogging roller is fed so far as it abuts against the closing type fence 9 so that the skew of the sheet is corrected. When the sheet abuts against the closing type fence 9 so that the jogging roller 12 stops, the spindle 28 still continues its rotation. As a result, the jogging roller 12 starts its rotation when the closing type fence 9 is opened, so that the sheet is discharged. Here, the torque limiters 27 are made of sliding clutches.

Next, the punching unit 6 is described. As shown in Fig. 12, the punching unit 6 is equipped on its side face with a handle 41. When the handle 41 is gripped and pulled, the punching unit 6 is removed from the punching device 1 so that it can be simply replaced by another. As shown in Fig. 13, positioning bosses 43 are disposed on the leading end face of the punching unit 6, as taken in the inserting direction, and on the reverse face of a flange panel 42 at the trailing end. When these positioning bosses 43 are fitted in the positioning holes of the frame 2, as shown in Fig. 3, the punching unit 6 is positioned.

As shown in Fig. 13, the distance L between the reverse face of the flange panel 42 for the positioning reference face of the punching unit 6 and the position of the punch 7 may

be slightly deviated by the tolerance or the assembly state of the individual parts. As a result, the punched holes are deviated perpendicularly to the transfer direction of the sheet.

Therefore, the punching unit 6 is equipped with positional deviation information storage means (or a positional deviation information storage unit 102) to send positional deviation information to a control unit (100) of the punching device 1. A read unit 101 disposed in the punching device 1 reads the positional deviation information. In accordance with the positional deviation information, a positional deviation elimination control unit 103 disposed in the control unit 100 of the punching device 1 controls the jogging mechanism 14c of the positioning plate 14a (or the reference positioning unit 14a), thereby to correct the position of the sheet in the direction perpendicular to the transfer so that the punched holes may not deviate.

Specifically, as shown in Fig. 12, a switch substrate 45 equipped with a plurality of dip switches 44 is mounted on the punching unit 6, and the (not-shown) connector plugs disposed at the leading end face, as taken in the inserting direction, are fitted in a socket S disposed in the frame 2 of the punching device 1 thereby to connect the switch substrate 45 and the control unit 100 of the punching device 1 electrically.

In the case of the 4-bit constitution having four dip switches mounted thereon, for example, positional information of 16 stages can be expressed. Since the positional deviation has

a small width, a remarkably precise positional correction can be made if a 4-bit signal is applied to the positional deviation. Not only the positional information but also information such as the hole number of the punching unit or the size of paper sheet to be applied may be added. Moreover, the dip switches may also be replaced by a nonvolatile memory as the positional deviation information storage unit.

Next, a punch driving mechanism is described. As shown in Fig. 3, the die plate 8 is fixed on a frame 46 of the punching unit 6. A punch support plate 47 having thirty punches 7 mounted thereon is so vertically slidably held that its two ends engage with slide guides 48 fixed on the frame 46.

Fig. 14 to Fig. 16 are three-face diagrams of the punch driving mechanism having its frame omitted; Fig. 17 is a perspective view taken obliquely from the front; and Fig. 18 is a perspective view taken obliquely from the back. Two links 49 are so symmetrically attached to the upper portions of the punch support plate 47 as can swing front and rear. The other ends of the links 49 engage with crank pins 51 at the two ends of a crankshaft 50. These two crank pins 51 have an identical rotational phase. When the crankshaft 50 is rotationally driven by the punch driving motor 10, the punch support plate 47 goes up and down in parallel so that the punch support plate 47 and the punches 7 make one reciprocation from an upper standby positions while the crankshaft 50 makes one rotation. At the descending time, moreover, the punches 7 are fitted in the

die 8 thereby to cause the punching treatment. In short, a punch ascending/descending mechanism is constituted of the punch driving motor 10, the links 49 and the crankshaft 50.

Coil holders 52 are mounted at portions near the two right and left ends of the upper portion of the punch support plate 47 and are equipped at their upper portion with vertical cylindrical portions 52a. These cylindrical portions 52a are slidably fitted on vertical guide pins 53 which are fixed on the upper portion of the frame 46, as shown in Fig. 3. As shown in Fig. 14 to Fig. 18, compression coil springs 54 are fitted around the cylindrical portions so that the punch support plate 47 is biased downward by the compression coil springs 54 while being fitted on the frame 46.

On the crankshaft 50, there is mounted a disc cam 55 which has one recess formed in one portion of the outer circumference. At an intermediate portion of a stop lever 56 attached to the frame 46, there is disposed a roller 57 which comes into engagement with the recess of the disc cam 55. Thus, a click stop mechanism of the crankshaft 50 is constituted by mounting a compression coil spring 58 in the stop lever 56 thereby to bring the roller 57 into elastic contact with the recess of the disc cam 55. As a result, the crankshaft 50 is held at an original angle so that the punch support plate 47 is fixed at the upper standby position (or a top dead center) against the spring force of the compression coil spring 54.

As shown in Fig. 3 to Fig. 8, moreover, a rotary disc 59 is mounted near the left end (as located on the lower portion in Fig. 7) of the crankshaft 50 so that the end of one cycle and the return to the original point are detected by detecting the notch formed at one portion of the outer circumference of the rotary disk 59 by a photo interrupter 60. Near the right end of the crankshaft 50, on the other hand, a rotary disc 61 having a number of radial slits is mounted near the right end of the crankshaft 50 so that the position of the punch support plate 47 is detected by a rotary pulse encoder composed of that rotary disc 61 (Fig. 7) and a photo interrupter 62.

When the punch driving motor 10 is started so that the crankshaft 50 and the disc cam 55 begin rotations, the stop lever 56 and the roller 57 are raised to disengage the roller 57 from the recess of the disc cam 55 so that the power through the crank pin 51 and the spring force of the compression coil spring 54 coact to move the punch support plate 47 and the punches 7 downward to perform the punching operations.

After the punch support plate 47 and the punches 7 passed through the bottom dead center, they rise in the rising stroke while compressing the compression coil springs 54 and then decelerate to reach the top dead center, and the roller 57 of the stop lever 56 engages with the recess of the disc cam 55 so that it stops at a predetermined position. In the rising stroke, the time period for the punch support plate 47 and

the punches 7 to stop is shortened by the decelerating action due to the reaction of the compression coil springs 54.

Thus, the punch support plate 47 and the punches 7 are biased downward by the compression coil spring 54 so that the load on and the power consumption by the punch drive can be reduced with improvements in the acceleration and deceleration to shorten the treating time period of one cycle, as compared with that of the punching device in which the punches are biased upward by the springs.

Subsequently, the closing type fence 9 of the punching unit 6 is described. As shown in Fig. 11, a spindle 63 for the closing type fence 9 is arranged at the rear of and above the die plate 8. Flat plate pawls 64 are attached at a suitable interval to the spindle 63 and are biased by the spring force of a torsional coil spring 65 so that they abut in vertical positions against the reverse face of the die plate 8. The spindle 63 is connected through a link 66 and a lever 67 to the fence driving solenoid 11. When the fence driving solenoid 11 is energized to pull the actuator, the link 66 is pulled up to rotate the spindle 63 so that the pawls 64 leave the reverse face of the die plate 8 thereby to open the passage for the paper sheet.

Next, the action steps of the punching device 1 are described with reference to the timing chart of Fig. 19. When the sheet is introduced from the copying machine at the preceding stage into the entrance of the punching device 1 so that the front

sheet detecting sensor 16 is turned ON, the sheet feed motor 18 is started, and the feed rollers 3 pulls and feeds the sheet forward.

When the leading end of the sheet touches to turn ON the rear sheet detecting sensor 17, the sheet discharging motor 26 is started to feed the sheet, as inserted between the jogging rollers 12 and the pinch rollers 13, rearward into abutment against the closing type fence 9. Simultaneously with this operation, the positioning plate driving motor 25 is started to reduce the spacing between the positioning reference plate 14a and the movable positioning plate 14b to the preset sheet width thereby to interpose the sheet transversely. The feeding extent after the jogging rollers 12 was started and before the sheet abuts against the closing type fence 9 is known, and the pinch rollers 13 rise for a short time period to release the pressure from the sheet after the feeding extent or the time, at which the sheet is construed to have abutted against the closing type fence 9. In case the skew of the sheet is found, the deviation is automatically corrected to bring the sheet into the position, in which the sheet has its sides arranged in precise position parallel to the two plates 14a and 14b.

After a time period (for the trailing end of the sheet to move over the sheet table 5) after the trailing end of the sheet passed through the front sheet detecting sensor 16, moreover, the rotary flap 15 turns 180 degrees to cover the trailing end of the sheet thereby to suppress the floating

of the sheet. After the movable positioning plate 14b stopped to hold the sheet, moreover, the pinch rollers 13 move downward to make elastic contact with the rotating jogging rollers 12 thereby to keep the sheet in position against the closing type fence 9. The spindle 28 of the jogging rollers 12 and the discharge rollers 4 are rotating till the end of the discharge of the sheet. However, the jogging rollers 12 having the torque limiters 27 stop rotations while applying the forward force to the sheet to push the same onto the closing type fence 9, and the spindle 28 is idly rotating.

After the pinch rollers 13 moved down, moreover, the punch driving roller 10 is started to descend the punches 7 into the punching actions, and the positioning plate 14b is reversely driven to return to an enlarged standby position. The ascending and descending stroke of the punches 7 is detected by the rotary pulse encoder composed of the rotary disc 61 attached to the crankshaft 50 and the photo interrupter 62, as shown in Fig. 4 to Fig. 8. When the punches 7 reach the lower end, the fence driving solenoid 11 is started to open the closing type fence 9.

When the punches 7 begin to ascend so that they leave the punched holes of the sheet, the jogging rollers 12 released from the rotational resistance reopens their rotations to feed the sheet so that the sheet is discharged by the discharge rollers 4. After a predetermined time period, the closing type fence 9 returns to the initial closed position, and the

discharging motor 26 stops to end the punching step of one cycle. In the punching device, the circumferential speed of the jogging rollers 12 is two times as high as that of the feed rollers 3 so that the sheet is fed according to the rotating speed of the feed rollers 3 while the sheet is being held by the feed rollers 3. When the trailing end of the sheet goes out of the feed rollers 3, the sheet is fed at the circumferential speed of the jogging rollers 12 on the downstream side, that is, at the speed of two times as high as that of the feed rollers 3. Even if, therefore, the succeeding sheet is fed overlapping the preceding sheet, there arises no fear that the two sheets are punched in the overlapping state.

Thus, the timings of the individual steps of the paper feed, the corrections of the positional deviation and the skew, the punching operation and the discharge are proceeded partially simultaneously while being overlapped in a time scale so that the operating speed is higher than the stepwise control after one step to the next.

Here has been described the embodiment of the punching device. It is, however, needless to say that the sheet feeding mechanism having the rotary flap, the position correcting mechanism by the positioning plate, and the sheet positioning/discharging mechanism by the closing type fence can also be applied to the sheet treating device of another type such as an electric stapler. Specifically, the foregoing embodiment has adopted the punching device as the aftertreatment

device, but the invention can be likewise applied to the sheet treating device which is equipped with the stapler as the aftertreatment device. Moreover, the present invention should not be limited to the foregoing embodiments but can be modified in various manners within the technical scope of the invention. It is apparent that the present invention covers those modifications.

The application is based on Japanese Patent Application (No. 2004-022148) filed on January 29, 2004, Japanese Patent Application (No. 2004-022151) filed on January 29, 2004, and Japanese Patent Application (No. 2004-022154) filed on January 29, 2004, and the contents of which are incorporated herein by references.

Industrial Applicability:

The sheet treating device is constituted to equip the end portion of the sheet table with the closing type fence so that the sheet is positioned against the closing type fence, and to open the closing type fence after the punching treatments thereto discharge the sheet. The sheet treating device can position the sheet highly precisely and can treat at a high speed.

Moreover, the torque limiting means such as the sliding clutches is disposed in the sheet feeding rollers for pushing the sheet onto the closing type fence 9 so that the roller

driving shaft can be rotated at all times thereby to have advantages in the high speed for the sheet feed and discharge.

Moreover, the two sheet feed rollers mounted on the spindle through the aforementioned torque limiting means are arranged at a spacing in the direction perpendicular to the sheet feeding direction. When the leading sheet end on the side of one jogging roller abuts against the closing type fence, the jogging roller is stopped in rotation, but the other jogging roller continues its rotation. As a result, the leading of the sheet on the latter jogging roller is fed till it abuts against the closing type fence thereby to correct the skew of the sheet.

Moreover, the sheet is transversely interposed by the positioning plates so that its transverse positional deviation and positional deviation relative to the feeding direction can be corrected.

Moreover, the constitution is made such that the paired sheet feed rollers are opened, when the positioning plates interposed the sheet transversely, to release the sheet. At the time of correcting the position, the sheet is not stressed to improve the correcting speed and precision.

Moreover, the constitution is made such that the individual steps of the sheet feed, the sheet position correction, and the punching operation and the discharging operation are overlapped in a time scale, thereby to remarkably improve the treating speed.

Moreover, the constitution is made such that the rotary flap is arranged at the upstream end of the sheet table so that it may turn, each time the sheet is fed onto the sheet table, to cover the upper face of the trailing end of the sheet. It is possible to eliminate a fear that the sheet to be continuously fed at a short interval to the sheet table jams or fails in the feed.

In the punching device of the invention, moreover, the punches are biased toward the die by the springs so that the punch driving force of the punch lifting mechanism and the spring force of the spring coact at the punching time to reduce the punching load and the power consumption and to raise the speed from the rotation to the stop of the punches thereby to improve the treating speed. Moreover, it is necessary to hold the punches at the standby positions against the forces of the springs. However, the crank pins of the crankshaft and the punches to be driven by the motor are connected through the links to constitute the punch lifting mechanism so that the punches can be held at the standby positions.

Moreover, the click stop mechanism for holding the punches at the standby positions is provided to ensure the standby position holding performance of the punches.

In case the punch lifting mechanism is constituted of the crankshaft and the links, moreover, the punches can be held highly precisely and reliably at the standby position by mounting the disc cam on the crankshaft and by holding the

roller or pawl elastically in the groove of the disc cam.

In the punching device of the invention, moreover, the positional deviation information on the punches and the die of the punching unit are stored in advance in the positional deviation information storage means. When the punching unit is mounted in the punching device, the positional deviation information is read out by the control unit so that the control unit controls the sheet positioning mechanism to correct the position of the sheet in the direction perpendicular to the transfer. As a result, even if the punch units are exchanged, the positions of the punched holes of the sheet are made identical so that they are not dispersed to improve the finishing precision.